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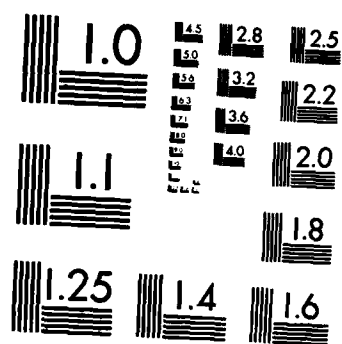
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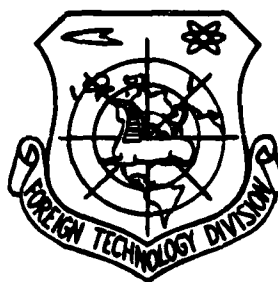
FOREIGN TECHNOLOGY DIVISION



ELECTRONIC EQUIPMENT IN MULTIPLE ACCESS INFORMATION SYSTEMS

by

Jacek Ochman



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ELECTRONIC EQUIPMENT IN MULTIPLE ACCESS INFORMATION SYSTEMS

Dr. Jacek Ochman

Introduction

Two parallel directions of activity can be distinguished at the present time in information enterprises in Poland: one embraces the construction of modern computer centers with the necessary installations, and the second embraces the construction of computer systems meeting the needs of the Polish national economy.

Along with the construction of large complicated systems, it has become necessary to conduct research in the area of data transmission organization for the needs of multiple access systems. At the same time new solutions are being sought in multiple access systems for more systematic use of electronic equipment to satisfy the constantly increasing needs for information services.

As our national experience shows, the basic way of covering the wide need for these services is centralization of computer power, achieved through the installation of large computers in computer centers rendering services for enterprises. Many services can be rendered through the installation of subscriber systems for the remote processing of problem oriented data.

Multiple access systems have the virtue that they make it possible for a large number of users to directly and simultaneously benefit from the computer potential of computers, obviously if the system is properly organized. Thus multiple access produces significant problems in the area of organizing the system itself, and particularly the organization of the digital system.

Three elements significantly affect the efficiency and cost reduction in organizing and using a multiple access system, namely:

--establishment of the proper profile of the system user,

- proper choice of the computer and its configuration, and
- choice of reliable data transmission equipment.

A solution to these problems can be presented using several multiple access information systems, now functioning in Poland, as an example.

One of the typical multiple access systems is the system called the POLRAX-2¹, designed and used by the Electronic Computer Technology Administration [ZETO] in Wroclaw. Since 1971 the venture of constructing the POLRAX-2 multiple access system has been achieved within the framework of a national critical problem, based on developing a typical multiaccess system on the basis of computers of national mass production, the ODRA 1300.

The profile of this system was defined on the basis of needs expressed by immediate users and with consideration of the opinions of many of the administrative personnel in the enterprises interested. The profile of this system, i.e., cooperation between the system and its environment and thus, in a broad sense, communication between users and system, was also based on the strategy of planning development of ZETO.

The purpose of the POLRAX-2 system was to render access to the computer and the use of its computer power possible for a large number of users.

In order to determine the material of adaptation, an analysis was made of a spread of users, drawing up lists of clients containing the following information about users:

- general characteristics of the user and his identification,
- location of the user and telecommunication address, and
- current and anticipated form of cooperation.

¹ RAX, from the English term "random access".

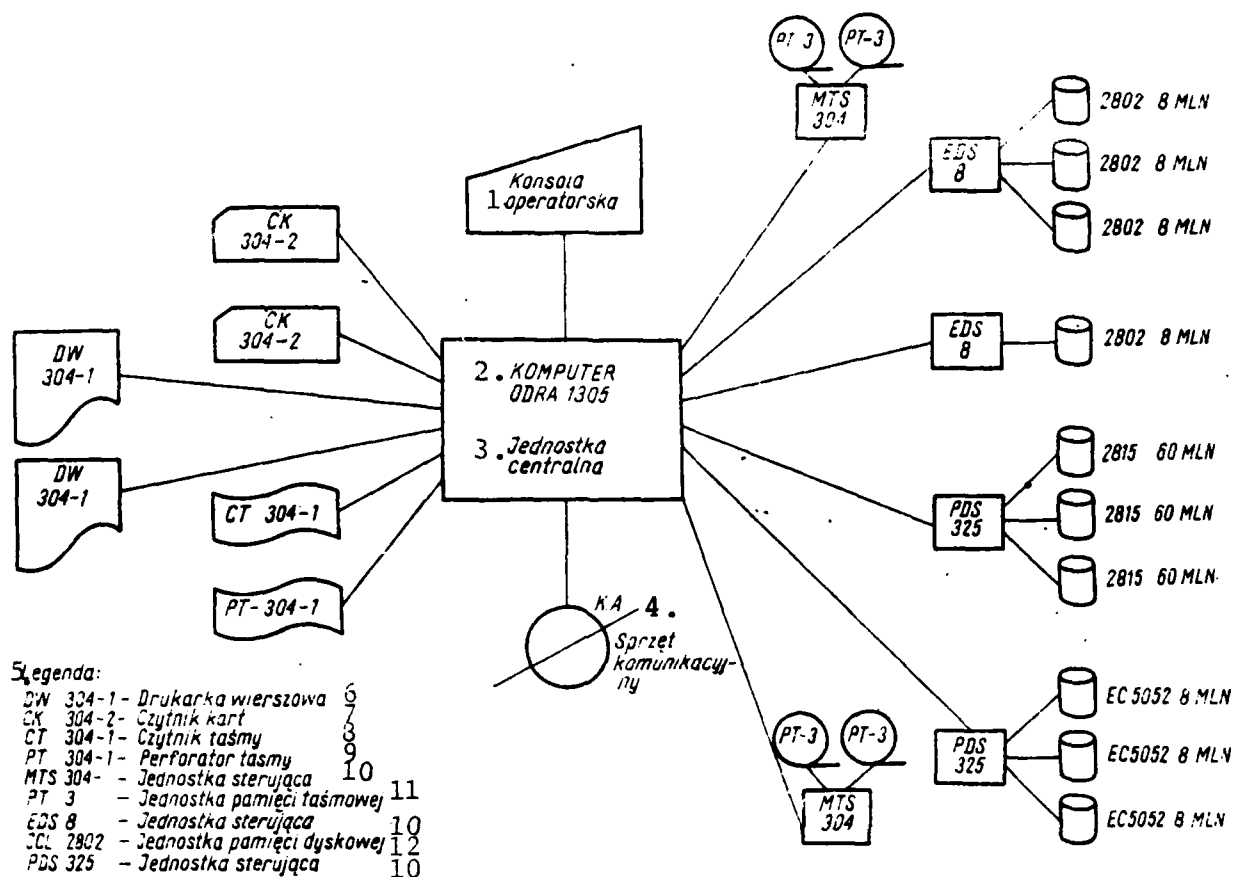


Figure 1. Configuration of the ODRA 1305 computer for the POLRAX-2 multiple access system. Key: 1-Operator console; 2-ODRA 1305 computer; 3-Central unit; 4-Communication equipment; 5-Legend; 6-Line printer; 7-Card reader; 8-Tape reader; 9-Tape punch; 10-Control unit; 11-Tape memory unit; 12-Disk memory unit.

The choice of the application material was particularly difficult, since ZETO is a service computer center. There is no doubt that proper anticipation of directions of changes in profile is one of the major factors determining the success of a center in the information service market.

The restrictions adopted because of familiarity with the information service market, state policy in the area of production and import of equipment, and personnel limitations, which were determined as a result of a simulation game played by the center administration, finally affected the installation of the elements and structure of the POLRAX-2 system.

In the construction of the system they used the current experience and achievements in the area of programming and adaptation for the ZETO center itself and its clients, assured possibility of easy exploitation of existing company programming, and selected solutions making its expansion possible through more efficient use of technological means and computer programs. The restrictions on this article do not permit detailed discussion of all the tasks mentioned above.

Description of the Computer Configuration for the POLRAX-2 System

The use of the system is based on the computer equipment of national production, the ODRA 1305, and data transmission equipment from the British company ICL (International Computers Limited).

The choice of this type of equipment was dictated by practical considerations, particularly:

- the use of a domestic computer simplifies the development and introduction of a multiaccess system without the need for additional training of staff;
- easy reproducibility of undertakings under domestic conditions, meaning a broad capability of adapting the system to other regions of the country; and
- reduction in costs of organizing and using the system.

The decision entailing the use of the ODRA 1305 central unit affected the choice of communication equipment.

The use of the data transmission equipment from the British ICL company resulted from two basic considerations:

- the lack of producers of this type equipment in socialist countries; and
- full interchangeability of equipment and programs between the ICL 1900 computer series and the ODRA 1300 (compatibility).

The configuration of the ODRA 1305 computer for the POLRAX-2 system as shown in Figure 1. For efficient operation of the POLRAX-2 multiple access remote system, the central unit should be equipped with at least 128 K words of operating memory. There is a possibility of further expansion to 256 K words.

The equipment mentioned below (table) is connected to the unit channels. Further expansion of the computer operating memory is anticipated (to 192 K in the current half year) and the direct access memory will also be increased in the future.

Tape reader	CT-304-1	1
Tape punch	PT-304-1	1
Card reader	CK-304-2	2
Line printer	DW-304-1	2
Tape memory adapter (4 tape units of type PT-3 are connected to the adapter)	MTS-304-1	2
Disc memory units ICL 2082	EDS 8 control unit	3
Disc memory unit EC 5052 (10 discs with a total capacity of about 236 million words are connected to all control units)	PDS 325 control unit	1
Operator monitor of the FACIT type		1

The configuration of the communication equipment has been presented in Figure 2 and includes the equipment in the message buffering system. This type of equipment is used in information networks with a high intensity of traffic. The ODRA 1305 central unit is relieved of the transmission process control functions, which enables more use to be made of its calculating power. The following apparatus is included in the above-mentioned equipment:

- ICL 7903/0 communication processor, which includes the F 1313 multichannel unit as a front-end buffer,
- a 7930/9 scanner selector,
- a 7930/1 universal scanner,
- a 7930/3 universal scanner, and
- units controlling the scanner 7930/0.

Apparatus enabling cooperation with telecommunication lines is attached to the scanner channels:

- GH 1151 A-11 modems with 200 bauds,
- GH 2054 A-11 modems with 1,200/2,400 bauds,
- 7924/2 display unit with control unit 7924/0, and
- 7922/2 line terminal units with control unit 7922/0.

The system services the following subscriber terminals:

--local remote printer	7071/3	4
--remote printers	7071/7	9
--terminals	ICL 7503	3
--screen monitor	ICL VDU 7181/2	1
--Datapoint terminal	2200	2
--terminal	RC 3600	3

Description of Communication Equipment

The communication processor ICL 7903/0, connected between the central unit and the scanner apparatus, performs the following functions:

- controls data transmission in a programmed way. The introduction of changes in the number of remote terminals does not lead to any need for changes in the processor hardware in this system;
- receives and complements characters from the scanner selector and transmits finished messages to the central unit;
- thanks to standardization of messages formed by the user program, it shortens and simplifies programming procedures in the central unit, and remote external equipment is used through a relatively small number of programs in the central unit; and
- it has a buffer memory making it possible to store messages.

In this regard transmission speed is not limited by the capabilities of the user program.

The 7903 telecommunication processor has a ferrite operational memory with a capacity of 24 K words. The words are byte structure. Each word consists of 16 bits, i.e., two 8-bit bytes. In the processor cabinet is a front-end processor model, composed of a buffer and a code converter. The buffer has a capacity of one word and is placed between the asynchronously operating processors. The converter processes the communication processor 8-bit code into a 6-bit code used in the central unit.

The 7930/9 scanner selector makes it possible to connect a varied number of scanners to a single Standard Interface processor 7903 and to adapt the level of signals used in the 7900 series apparatus to the requirements of the central unit.

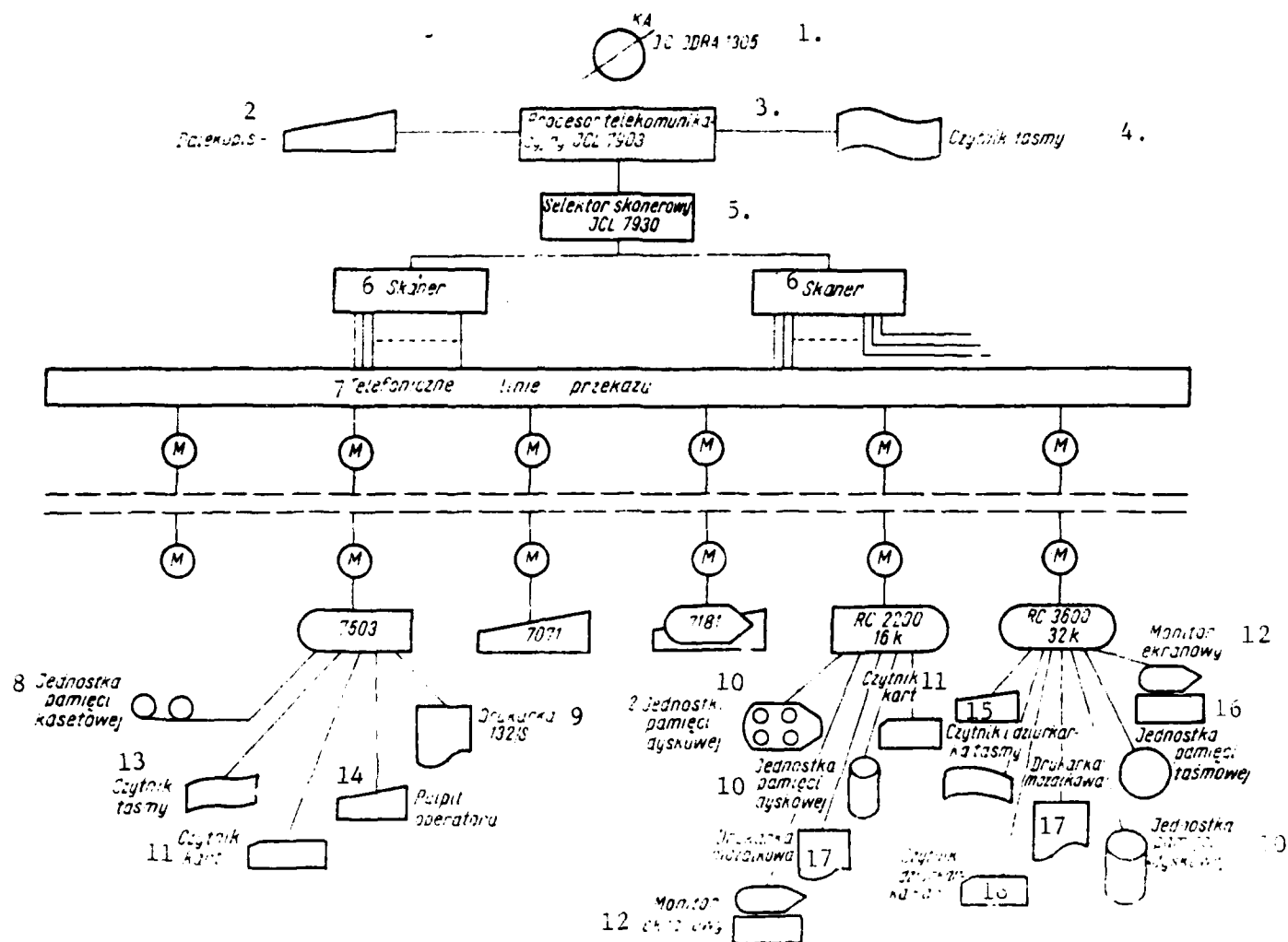


Figure 2. Configuration of the communication equipment for the POLRAX multiple access system. Key: 1-ODRA 1305 computer; 2-Remote printer; 3-Telecommunication processor; 4-Tape reader; 5-Scanner selection; 6-Scanner; 7-Telephone order lines; 8-Cassette memory unit; 9-Printer; 10-Disc memory unit; 11-Card reader; 12-Screen monitor; 13-Tape reader; 14-Operator console; 15-Punched tape reader; 16-Tape memory unit; 17-Dot matrix printer; 18-Punched card reader.

The 7930/1 and 7930/3 universal scanners are units participating in the reception of information from the telecommunication lines by the communication processor and vice versa. The individual bits of information taken from the modem interfaces are complemented in sign in the sign buffers, for each line, and then transmitted toward the processor. In addition the scanners fulfill such functions as: conversion of the internal code of the ICL 1900 and the 8-bit transmission code, detection of characters controlling ECMA/ISO, and additional nonstandard characters, and control of character parity.

GH 1151 A-11 and GH 2054 A-16 Modems Make It Possible to Transmit Data Through Telegraph or Telephone Lines. The line terminal units make it possible to convert signals between the telegraph line interchange and the interchange to the scanner connection. The modems perform the modification of signals required by the equipment in series 1900, into a form possible for transmission through the telephone lines and vice versa. The GH 1151 A-11 modems make it possible to work at full-duplex¹ on one-way or two-way connections at a rate of 200 b/s, while the GH 2054 A-16 modem works at a frequency of 1,200 or 2,400 b/s. Both types of modems can cooperate with telephone apparatus, and the line-telephone switch can be controlled either automatically or manually.

The 7942/2 display units with control unit 7924/0 and the line terminal unit 7922/2 with control unit 7922/0 are groups of apparatus making it possible to transmit data through telegraph or telephone lines. The line terminal units convert signals between the telegraph line interface and the interface to the scanner connection.

¹ Work in full-duplex is a simultaneous exchange of information in two directions, requiring the use of two-way connections.

Two types of printers operate in the system: local 7071/3 and remote 7071/7.

The remote printers work by means of telephone lines and modems. The local printers are attached by telegraph lines to the so-called line terminal units, which adapt signals received from telegraph lines to the requirements of the CCiTT interface (input into the scanner channel). With respect to functionality, both types of printers have the same parameters. This equipment makes it possible to transmit and receive messages of variable length. The maximal rate of operation is nine characters/second. The data at output are generated in the ICL transmission code.

The 7071 printer apparatus has a keyboard and a tape reader, by means of which data are input, and then output with the printer and tape punch. Printers make it possible to work on local and on-line modes. In the first case the user of the equipment can, with its aid, prepare data in the following combinations: keyboard-printer-tape punch, tape reader-printer-tape punch, i.e., using the source apparatus to output data on any output equipment or on two pieces of output equipment at one time. In on-line work the printer is connected to the system and makes it possible to input and output data in a conversational mode. Information transmission follows a start-stop system, i.e., each character transmitted is equipped with start and stop bits. The information transmitted through the line is coded in the ICO-7 code, which was designed and approved by the CCiTT International Committee. The printer keyboard is equipped with a number of suitable character keys, including alphanumeric and control characters. The printers do not have any systems for the automatic detection of errors. The operator can have erroneous information retransmitted after inputting the proper message.

The ICL 7503 remote terminal, with its 7503/1 processor (minicomputer) makes it possible to connect a certain amount of peripheral equipment, such as card reader, line printer, VDU console and printer, cassette winder, etc. The standard installation includes at least one magnetic cassette reader to load the program and an operator console for the operator to control the processor. The terminal can be used on-line, attached to another terminal (terminal-terminal) or to another processor, directly through a telephone line. It can also be programmed for local data copying or data output. The processor capacity runs from 16 to 64 k bytes, and can be increased by 8 k by adding successive memory packages. In the POLRAX-2 system the apparatus operates with a software reading emulator, which guides all transmission control processes and the selection of individual peripheral equipment. The terminal operates in a batch system through a remote ICL 7020 station. Data can be transmitted at a rate of 600 to 4,800 b/s.

The VDU 7181/2 screen monitor. This is used in the POLRAX-2 system for interactive work. The equipment includes an alphanumeric keyboard with a repertoire of 92 characters and a screen with a capacity of 2,000 characters. The information is displayed in the form of 25 lines, with 80 characters per line.

The monitor has a buffer memory. Messages written by the operator on the keyboard are held in the buffer and printed on the screen. Message compilation or editing can be done without communicating with the processor, unless transfer of a complete text is involved. The monitor makes it possible to transmit data at rates up to 4,800 b/s. Some type of printer can be connected to the monitor for the purpose of obtaining a copy of text displayed. Message formatting and retransmission of erroneous information is under the control of the processor.

DATAPOINT 2200 Minicomputer

1. Components. The DATAPOINT 2200 minicomputer, bought by ZETO from A/S REGNECENTRALEN, is composed of the following systems:

- processor with operating memory,
- screen monitor,
- card reader,
- dot matrix line printers,
- two cassette tape memory units, and
- keyboards.

2. Programming. The company programming system secured by ZETO includes:

- operational system (CTOS),
- ASSEMBLER 4, translator language,
- EDITOR programs,
- DATABUS language,
- 7020 emulator,
- technical tests, and
- demonstration programs.

3. Application. The DATAPOINT 2200 configuration makes both local and remote work possible, as an EMC terminal of the ODRA 1305. As a terminal it can operate through telecommunications lines and data transmission equipment, and as a terminal for the batch processing of data, simulating the JCL 7020.

The DATABUS language makes it possible to conduct a broad spectrum of work in the area of data processing in a closed system. The existence of additional (calculating) programs and ease in programming make it possible to use DATAPOINT 2200 for calculations of the APZ and similar types.

Terminals are connected to the POLRAX-2 system on the basis of RC 3600. In a typical terminal configuration there is also equipment, such as: a line printer, card reader and punch, and paper tape reader and punch. The terminal memory equipped with the 7020 software emulator will be able to fulfill any function in controlling the processes of transmitting and sending data from and to the system.

The 7020 terminal and its equipment must be connected when remote batch processing is done through telephone lines. The 7020/4 remote processing station includes a half-duplex communication terminal working at a rate of 2,400 b/s, to which can be connected:

- a 7028/1 paper tape reader (250 characters/second),
- a 7028/1 paper tape printer (110 characters/second),
- a 7022/1 card reader (320 cards/minute),
- a 7021/4 line printer (612 lines/minute), and
- a 7023/3 monitor (10 characters/second).

The remote processing station enables the input and output of a large amount of data to and from the central processor to and from the remote terminal equipped with the peripheral equipment.

The remote input of tasks into the installation under the operating system GEORGE makes it possible to transmit from the terminal source programs, results and data , and to control all the work processed on the computer. In addition it enables local work between the input and output equipment of the stations (copying, listing).The communication equipment will be expanded from the viewpoint of including a larger number of subscribers. This is associated with adding a certain number of remote terminals to the system.

Brief Presentation of POLRAX-2 Programming

In implementing the POLRAX-2 system they adopted a digital system of the third generation with the operating system GEORGE-3 (General Organizational Environment), which enables local batch processing performed on the spot in the center and remote and interactive batch processing, where communication with the system is provided by means of a terminal.

The choice of the operating system GEORGE-3 was primarily dictated by the need for efficient use of the calculating power of the central unit of the ODRA 1305 computer. Nevertheless, the system enables many users remotely connected to the computer to work at the same time, which is of particular significance in the current state of development of the application of information theory.

In the POLRAX-2 system GEORGE-3 essentially performs seven principal tasks:

- it guarantees the parallel work without interference of all external equipment and increases their capacity by applying suitable technology in inputting data and outputting results;
- it increases the efficiency of using computer facilities, such as: arithmetic unit, operating memory, communication equipment, external apparatus, software, routines, etc.;
- it enables joint use of the system by many users at the same time and achieves satisfactory response time for users working on-line;
- automates realization of processing on a basis of a given program in a task description language and reports the state of the task (program);
- automatically clears the computer of the user;
- protects against unauthorized access to computer facilities and protects the user against the negative results of system failure; and

--makes possible the addition of new functions and new users, which permits the system to be expanded as needed.

To summarize the above, GEORGE-3 administers the entire computer installation. Each acceptance of a user into the POLRAX-2 system is associated with the assignment to him of a place in direct connection with external program equipment, a place for indirect input of a routine into the Routine Systems Memory, a place for indirect output of data on external equipment, and time and financial resources. Under the above assumptions GEORGE-3 in the POLRAX-2 system makes it possible to plan for the permissible participation of all clients in using the digital system resources.

Before any task is begun, the budgets in these categories are automatically verified, being one of the conditions for access of a task for processing and, after conclusion of the task, the budgetary allowances are reduced by the charge for using the facilities. In the POLRAX-2 system, as a multiple access, this is of particular significance since budgetary control is impossible with a right to automatic access of many remote users to the machinery.

The tasks of multiple access users have priority over the batch jobs of the computer center. Part of GEORGE has been used for this purpose, connected with the multiple access known as MOP (Multiple On-Line Programming), which permits the simultaneous actuation of the jobs of a certain number of users, while implementation of batch jobs is given secondary importance.

The languages of the operational command system assure the possibility of communication between the users and the processor in the MOP multiple access system. The following interactive languages can also be used:

--JEAN, a simple language of arithmetic and logic expressions used mainly for basic construction calculations.

--BASIC, a language close to FORTRAN with simplifications in the inputting and outputting of information and in matrix activities and also used for all scientific and technological calculations;

--FORCON, a system for the FORTRAN language used like BASIC.

Work in the multiaccess system by means of interactive languages is based on the user giving the terminal simple commands to access and transmit data and to obtain concrete results from the machine. The advantages of the interactive work in the POLRAX-2 system are:

--great simplicity of operation,

--ease in servicing terminals,

--great rate of data output,

--high response speed and

--free access to computer.

The GEORGE-3 operating system used in POLRAX makes it possible for the clients to create their own useful programs because of the simple and efficient compiler for the following languages: PLAN, COBAL, FORTRAN and ALGOL.

With his terminal the POLRAX-2 system user can control the work of his own programs, beginning and ending his own batch jobs. Instructions input by users are immediately compiled and used, making immediate correction of errors in instructions possible, which greatly shortens the programming cycle time and the computer task realization.

Fundamentals of Using the POLRAX-2 System

In order to coordinate the work associated with the operation of the POLRAX-2 system, a POLRAX-2 system Council of Users was set up. The tasks of the Council of Users include:

--supervising the proper function of the system, and
--coordination of work by modifying the systems profile.

Three groups of users exist within the POLRAX framework:

- a) users processing data,
- b) users performing scientific and technological calculations, and
- c) users performing scientific and technological calculations and processing data.

Figure 3 presents the structure of user activity in the POLRAX-2 system, and the table illustrates the subject matter range of work done.

Within the framework of these groups ZETO coordinates the work of individual users, directs the flow of information, trains and gives consultations.

At the present time ZETO guarantees work in the multiaccess system during the working hours of the institute, but assures the calculating power of the machine at an amount of approximately 1,250 hours monthly for all users.

The basic user call is notification of his desire to use the system by supplying:

- enterprise name,
- address,
- bank account,
- subject matter,
- data on order proxy,
- budgets required, and
- basis for accessing (client's letter, contract order, proposal, etc.).

On the basis of the expressed need and the possibilities, the executive (ZETO) makes a decision about the user application. In case the request is accepted, the following are determined: the names of the user in the Systems Routine Memory, the terminal validity and the digital system budgets.

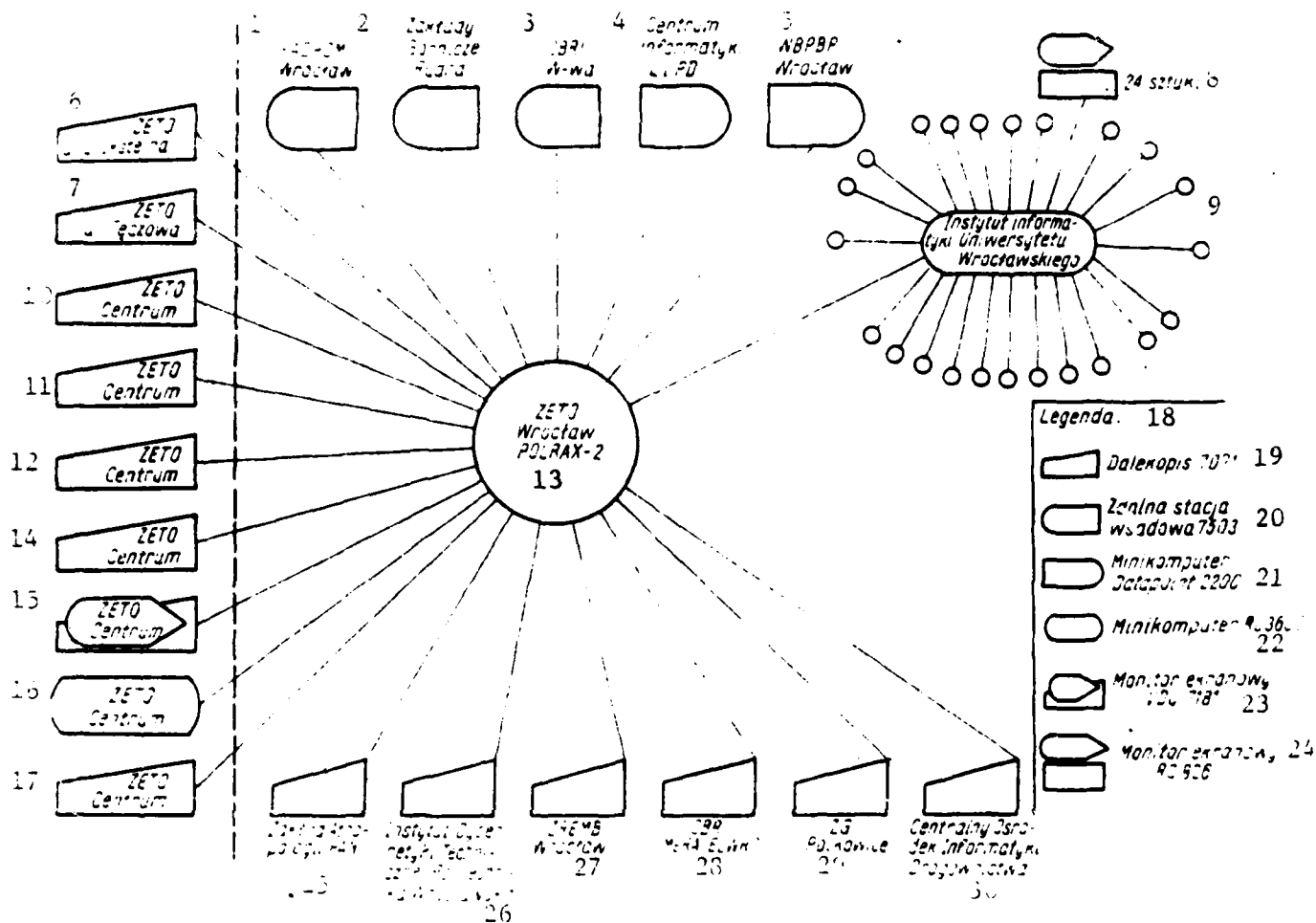


Figure 3. POLRAX-2 system users. Key: 1-FADROM Wrocław; 2-Rudna Mining Plant; 3-OBRI Warsaw; 4-L and PD Information Center; 5-WBPBP Wrocław; 6-ZETO, ul. u. [street] Dicksteina; 7-ZETO, ul. Teczowa; 8-24 units; 9-University of Wrocław Information Institute; 10-ZETO Center; 11-ZETO Center; 12-ZETO Center; 13-ZETO Wrocław POLRAX-2; 14-ZETO Center; 15-ZETO Center; 16-ZETO Center; 17-ZETO Center; 18-Legend; 19-7071 printer; 20-Remote batch station 7503; 21-Data point 2200 minicomputer; 22-RC 3600 minicomputer; 23-VDU 7181 screen monitor; 24-RC 826 screen monitor; 25-PAN (Polish Academy of Sciences) Administration of Anthropology; 26-Wrocław Polytechnical Institute of Cybernetics; 27-ZREMB Wrocław; 28-OBR MERA-ELWRD; 29-ZG Polkowice; 30-Central Information Office of Highway Engineering.

1 Użytkownik	2 Rodzaj końcówki	3 Profil zastosowania
ZETO CENTRUM	ICL 7071 (4 szt.)	Prace programistyczne. Uruchamianie i testowanie systemów. Konserwacja i rozwój systemu wielodostępnego.
ZETO TECZOWA (Ulica)	ICL 7071	Obliczenia inżynierskie.
ZETO DICKSTEINA (Ulica)	ICL 7071	Prace programistyczne. Uruchamianie i testowanie systemów
ZETO INTE	ICL 7181	Ewidencja i wyszukiwanie informacji bibliograficznych.
ZAKŁAD ANTROPOLOGII PAN	ICL 7071	Programy analizy statystycznej.
Instytut Cybernetyki Technicznej		
POLITECHNIKA WR.	ICL 7071	Prace programistyczne.
ZREMB WROCŁAW	ICL 7071	Obliczenia inżynierskie. Lista plac.
OBR MERA - ELWRO	ICL 7071	Prace programistyczne.
COID WARSZAWA	ICL 7071	Prace programistyczne
(Centralny Ośrodek Informatyki Drogownictwa)		
FADROMA WROCŁAW	ICL 7503	System PROMPT w zarządzaniu przedsiębiorstwem.
Zakłady Górnicze RUDNA	ICL 7503	Gospodarka materiałowa. Ewidencja kadrowa.
OBRI WARSZAWA	ICL 7503	Zestawienie dla Ministerstwa Szkolnictwa Wyzszego, Nauki i Techniki
WBPBP WROCŁAW	DP 2200	Obliczenia inżynierskie.
CILIPD POZNAŃ	DP 2200	Obliczenia inżynierskie
(Centrum Informatyki Leśn. Przem. Drzew.)		
Instytut Informatyki		
UNIwersytet Wrocł.	RC 3600 (VDU)	Dydaktyka w zakresie informatyki. Języki konwersacyjne.
ZETO CENTRUM	RC 3600	Wdrażanie minikomputerów do pracy w syst. wielodostępnych.

Figure 4. Subject matter range of work performed in the POLRAX system
(as of 1 January 1977).

User	Type of Terminal	Profile of Use
ZETO CENTRUM	ICL 7071 (4)	Programming work. Systems implementation and testing. Maintenance and Development of multiaccess system.
ZETO TECZOWA (street)	ICL 7071	Engineering calculations.
ZETO DICKSTEINA (street)	ICL 7071	Programming work. Systems implementation and testing.
ZETO INTE	ICL 7181	Files and seeking bibliographic information.
PAN (Polish Academy of Sciences) Anthropology Administration	ICL 7071	Statistical analysis programs.

Figure 4 (Continued)

<u>User</u>	<u>Type of Terminal</u>	<u>Profile of Use</u>
Institute of Technical Cybernetics		
Wroclaw Polytechnical Institute	ICL 7071	Programming work.
ZREMB Wroclaw	ICL 7071	Engineering calculations. Salary list.
OBR MERA - ELWRO	ICL 7071	Programming work.
COID (Central Information Office of Highway Engineering)	ICL 7071	Programming work.
FADROMA WROCLAW	ICL 7503	PROMPT system in enterprise administration.
RUDNA Mining Plant	ICL 7503	Material economy. Personnel records.
OBRI WARSAW	ICL 7503	Statements for the Ministry of Higher Education, Science and Technology.
WBPBP WROCLAW	DP 2200	Engineering calculations.
CILIPD (Information Center of Forestry and the Timber Industry)		
Institute of Information Science		

Figure 4. (Continued)

<u>User</u>	<u>Type of Terminal</u>	<u>Profile of Use</u>
University of Wroclaw	RC 3600 (VDU)	Teaching material in the area of information science. Interactive languages.
ZETO CENTER	RC 3600	Introduction of minicomputers into the work in multiple access systems.

The above information is transmitted to the section concerned with safeguarding the system which acknowledges the user of the system. The user proxy obtains confirmation of the acceptance along with his password.

An index of cells according to the administration compulsory in ZETO is used to define the users for work carried out through the organizational units of ZETO.

The entire potential of the installation resources is shared among users of the system by means of a user card file MANAGER. If a user transfers part of his budget to his subordinates, that part is subtracted from his budget.

Three basic kinds of budgets are distinguished: place, time and amount to be paid for work performed.

The place budget is an allocation of a place in the system and is measured, for example, by the amount of magnetic tape or memory words.

The time budget refers to the working time of the central unit and is an assignment of time to perform tasks of varied urgency.

The financial budget is the amount of money or of contracted units assigned to the user to be paid for services performed by ZETO.

The GEORGE-3 operating system has a functioning program which systematically calculates the financial obligations for work performed in the system. Using this program it calculates the charge for the memory used, the processor time and the use of external equipment by individual users of the system.

Service of the Data Transmission Network and the Subscriber Terminals

POLRAX-2 is based exclusively on a telephone connection network. Keeping in mind the poor state of the national telecommunications network, the system has adapted leased lines, making it possible to transmit data at a rate of 1,200/2,400 b/s. The data transmission system is achieved on the existing telecommunications network under the administration of the Polish Post Office, Telephone and Telegraph (PPTiT). The PPTiT is responsible for the proper maintenance of communication and assurance of proper parameters in accord with the recommendations of the CCITT International Committee and prompt elimination of breakdowns.

The preservation and service of the engineering equipment for the computer presents no difficulties nor problems, and is handled by ZETO. However, a need has arisen to organize certain specific equipment services within the users' systems. Achievement of the POLRAX-2 system has led to the implementation of service for subscriber terminals, assuring safeguarding and the elimination of damage to the communication equipment of the system.

Location of failures in the communication lines is also one of the service obligations. In this regard terminal service is interested in the proper functioning of the equipment, beginning with the scanner channel at the user's end.

Final Comments

The article has presented the results of research in the functioning area of the POLRAX-2 system, which was organized in ZETO in Wroclaw.

On the basis of the findings it can be said that the achievement of the data transmission network under the conditions of our country is still meeting many difficulties, particularly:

- an insufficient amount of suitable equipment making it possible to introduce multiple access systems on a larger scale;
- a lack of free pairs in local lines and interurban lines;
- organizational difficulty in the area of the ownership of lines and other data transmission equipment; and
- a shortage of suitably trained specialized personnel.

However, despite these difficulties, it has been determined on the basis of this research that the use of the POLRAX-2 system provides many benefits, of which the following deserve emphasis:

- the suitability of the system to provide data at various geographic areas and the possibility of analyzing large sets of data;
- the possibility of rapid recording of transactions and conducting transactions at considerable distances;
- the possibility of multi-subject analysis of data and the short time from the moment of data registration to the moment current information is provided;
- a possibility of simultaneous service to many users; and
- the rapidity of reaction to irregularities occurring in the control processes, and the possibility of controlling many parameters at one time.

Summing up, it can be said that the introduction and use of the POLRAX-2 system on the basis of the information equipment mentioned above implies a number of benefits, the most important of which are the reduction in data processing costs and satisfaction of needs on the information service market.

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